Claims

1. A method of determining a birefringence property of a sample, comprising the steps of:

separately directing through the sample a first beam of polarization-modulated light having a first wavelength and a second beam of polarization-modulated light having a second wavelength, the first and second wavelengths being different;

modulating the polarization of the first and second beams after those beams pass through the sample;

analyzing the first and second beams;

detecting the intensity of the first and second beams; and

calculating an actual birefringence property of the sample based on the detected intensities.

2. The method of claim 1 wherein calculating includes:

identifying two or more measured birefringence properties; and

determining the actual birefringence property from among the measured birefringence properties.

3. The method of claim 2 wherein the determining step includes selecting the actual birefringence property from among the identified measured birefringence properties depending upon differences between the measured birefringence properties as compared to differences between the first and second wavelengths.

4. The method of claim 2 wherein the determining step includes selecting the actual birefringence property to be one of the measured birefringence properties in instances where the one measured birefringence properties is equal to another measured birefringence property.

5. The method of claim 1 further comprising the step of determining the actual birefringence property to include magnitude.

6. The method of claim 1 further comprising the step of determining the actual birefringence property to include angular orientation.

7. The method of claim 1 further comprising the step of determining the actual birefringence property to include both magnitude and angular orientation.

8. The method of claim 1 including the step of providing the first and second wavelengths to be about 157 nanometers.

9. The method of claim 8 including the step of providing the sample as a calcium fluoride optical element.

10. The method of claim 1 including the step of providing a sample that is selected to be of a thickness such that the actual birefringence property will include a magnitude that is greater than one quarter of either the first or second wavelengths.

11. The method of claim 10 wherein the sample is selected to be of a thickness such that the actual birefringence property will include a magnitude that is as large as either the first or second wavelengths.

12. The method of claim 2 wherein the determining step includes selecting the actual birefringence property from among the identified measured birefringence properties depending upon how near the magnitude of one of the identified measured birefringence properties is to one-quarter increments of the first wavelength.

13. The method of claim 12 including the step of selecting the second wavelength to be about 20% of the first wavelength.

14. The method of claim 1 including the steps of:

periodically moving the sample so that the beams are directed through a plurality of locations on the sample; and

calculating an actual retardance property of the sample at each location.

15. The method of 1 including the step of simultaneously graphically displaying the retardance magnitude and angular orientation of substantially all of the locations.

16. A method of measuring birefringence properties of a sample, comprising the steps of:

separately directing through the sample at least three light beams comprising a first beam of polarization-modulated light having a first wavelength, a second beam of polarization-modulated light having a second wavelength, and a third beam of polarization-modulated light having a third wavelength, the first, second, and third wavelengths being different from one another;

modulating the polarization of the first, second, and third beams after those beams pass through the sample;

analyzing the first, second, and third beams;

detecting the intensity of the first, second, and third beams; and

calculating an actual birefringence property of the sample based on the detected intensities.

17. The method of claim 1 wherein calculating includes:

identifying three or more measured birefringence properties; and

determining the actual birefringence property from among the measured birefringence properties.

18. The method of claim 17 wherein the determining step includes selecting the actual birefringence property to be one of the measured birefringence properties in instances where the one measured birefringence property is equal to another measured birefringence property.

19. A system for measuring birefringence properties in a sample, comprising:

a source of two or more beams of light having wavelengths that are different from one another;

means for modulating the polarization of the light beams;

means for separately directing the beams through the sample;

means for analyzing the beams after the beams pass through the sample; and

detection means for detecting the intensity of the beams, thereby to provide information suitable for calculating a birefringence property of the sample based on the detected intensities.

20. The system of claim 19 wherein the means for separately directing includes a deuterium lamp and a monochromator.

21. The system of claim 19 wherein the sample comprises calcium fluoride having a thickness of up to about 270 millimeters.

22. The system of claim 19 wherein the wavelengths of the source light are about 157 nanometers.

23. The system of claim 19 wherein the means for modulating the polarization of the light beams comprise a pair of photoelastic modulators.

24. A method for selecting a process from a plurality of processes for measuring a birefringence property of a sample, which processes include directing at least one beam of light of a given wavelength through the sample, the method comprising the steps of:

estimating the range of the birefringence property of the sample; and

selecting the process for measuring the birefringence property depending upon the estimated range.

25. The method of claim 24 including the steps of:

selecting a first process from the plurality of processes if the estimated range is less than about 6% of the given wavelength; and

selecting another of the plurality of processes if the estimated range is more than about 6% of the given wavelength.

26. The method of claim 25 including the steps of:

selecting a second process from the plurality of processes if the estimated range is more than about 6% of the given wavelength; and

selecting a third process from the plurality of processes if the estimated range is less than about one-quarter of the given wavelength.

27. The method of claim 26 including the steps of:

selecting a fourth process from the plurality of processes if the estimated range is more than about one quarter of the given wavelength and less than about one-half of the given wavelength;

wherein the fourth process includes the first and second processes.

28 A method of aligning optical elements of a system for measuring birefringence properties in a sample, wherein the system includes a first and second photoelastic modulator (PEM), each PEM having an optical axis and operable for modulating the polarity of a light beam that passes though the sample, the system also including a polarizer associated with the first PEM, an analyzer associated with the second PEM, and a detector for measuring the intensity of the light beam after the beam passes through the PEMs, polarizer, and analyzer, the method comprising the steps of:

fixing the optic axis of the first PEM;

operating the first PEM while the second PEM is off;

rotating the polarizer while monitoring the measured intensity of the light beam;

noting the rotational position of the polarizer when the measured intensity corresponding to a first harmonic frequency of the light beam is at a minimal value;

rotating the polarizer by 45 degrees beyond the noted rotational position;

rotating the analyzer until a second harmonic frequency of the modulated light is at a minimal value; and

rotating the second PEM until a second harmonic frequency of the modulated light beam is at a minimal value.

29. The method of claim 28 wherein the operating step includes operating the first PEM at quarter-wave peak retardation.

30. The method of claim 28 including the step of ensuring that the polarizer and analyzer are approximately initially oriented at +45 degrees and –45 degrees, respectively.